

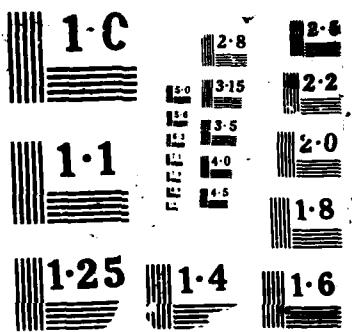
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In 1984, the Army completed a comprehensive study of the known and anticipated digital terrain data requirements of approximately 75 systems/applications. The Defense Mapping Agency (DMA) recognized this digital topographic data requirement in 1985 and indicated that production against this requirement could begin in the early 1990s, once their MK90 Production System was in place. Since its recognition as an Army requirement, TTD has been the subject of negotiations between DMA and Army, Navy, Marine Corps, and Air Force representatives. In Jul 1986, DMA organized a Joint DOD TTD Working Group to serve as a forum to further refine the overall design and characteristics of TTD to better support the multiplicity of intended uses by joint land combat forces in the future.

The Army is actively participating in this working group which is addressing data content, format, media, and other related TTD issues. A prototype TTD specification has been defined and DMA is in the process of producing a 15' x 15' cell that will be completed by the end of this calendar year. This prototype cell will be distributed to DOD, industry, and

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THE EVOLUTION OF TACTICAL TERRAIN DATA (TTD)

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ABSTRACT

In 1984, the Army completed a comprehensive study of the known and anticipated digital terrain data requirements of approximately 75 systems/applications. The Defense Mapping Agency (DMA) recognized this digital topographic data requirement in 1985 and indicated that production against this requirement could begin in the early 1990s, once their MK90 Production System was in place. Since its recognition as an Army requirement, TTD has been the subject of negotiations between DMA and Army, Navy, Marine Corps, and Air Force representatives. In Jul 1986, DMA organized a Joint DOD TTD Working Group to serve as a forum to further refine the overall design and characteristics of TTD to better support the multiplicity of intended uses by joint land combat forces in the future.

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Requirement Evolution

It is important to recognize that definition of the Army's requirement for digital topographic data has not occurred overnight, but rather, has been an evolutionary, iterative process beginning in earnest in 1980. In October of that year, the Army requested that DMA produce a prototype data set to assist in defining the content, format, accuracy, and resolution requirements of a future digital topographic data base. In 1982, following DMA's completion of a prototype for areas in Ft. Lewis and Yakima Firing Center, Washington, the Army initiated a comprehensive study that lasted two years. During the first phase of this study, Army evaluators studied the content, format, accuracy, and resolution of these prototype data sets and tested their adequacy for terrain analysis support. The study's second



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phase examined the data sets in terms of terrain data requirements which will be generated by existing and planned tactical and training systems. As part of this effort, over 75 Army activities were contacted.

In Oct 1984, following completion of this comprehensive study, the Army stated its requirement for digital topographic data to DMA. This stated requirement defined a multi-use data set capable of supporting a broad range of land combat functions and systems in the 1990s and beyond. In Oct 1985, DMA recognized this digital topographic data requirement and indicated that production against this requirement could begin in the early 1990s, once their MK-90 Production System was in place.

Joint Participation

Since its recognition as an Army requirement, Tactical Terrain Data (TTD), as it is now called, has been the subject of negotiations between DMA and Army, Navy, Marine Corps, and Air Force representatives. In Jul 1986, DMA organized a Joint DOD TTD Working Group to serve as a forum to further refine the overall design and characteristics of TTD to better support the multiplicity of intended uses by joint land combat forces in the future. To this end, selected 1:50,000 scale Combat Chart information on near shore hydrographic features have been added to the data set for intended Marine Corps' uses. This is in addition to the remainder of the data set that includes an enhanced Tactical Terrain Analysis Data Base, selected features from the 1:50,000 scale Topographic Line Map, and a DTED Level II elevation matrix. The content of TTD is shown graphically in Figure 1.

Prototype Development

In order to provide the services with "hands-on" knowledge of TTD, DMA is in the process of producing a prototype 15'x 15' cell over Ft. Hood, TX. This cell, scheduled for completion on 31 Dec 1987, is DMA's "best shot" at providing a data set that simulates their production capabilities of the 1990s. A synopsis of TTD characteristics, to include information on content, area coverage, accuracy, applications, etc., is provided in Table 1.

TACTICAL TERRAIN DATA (TTD) CONTENT

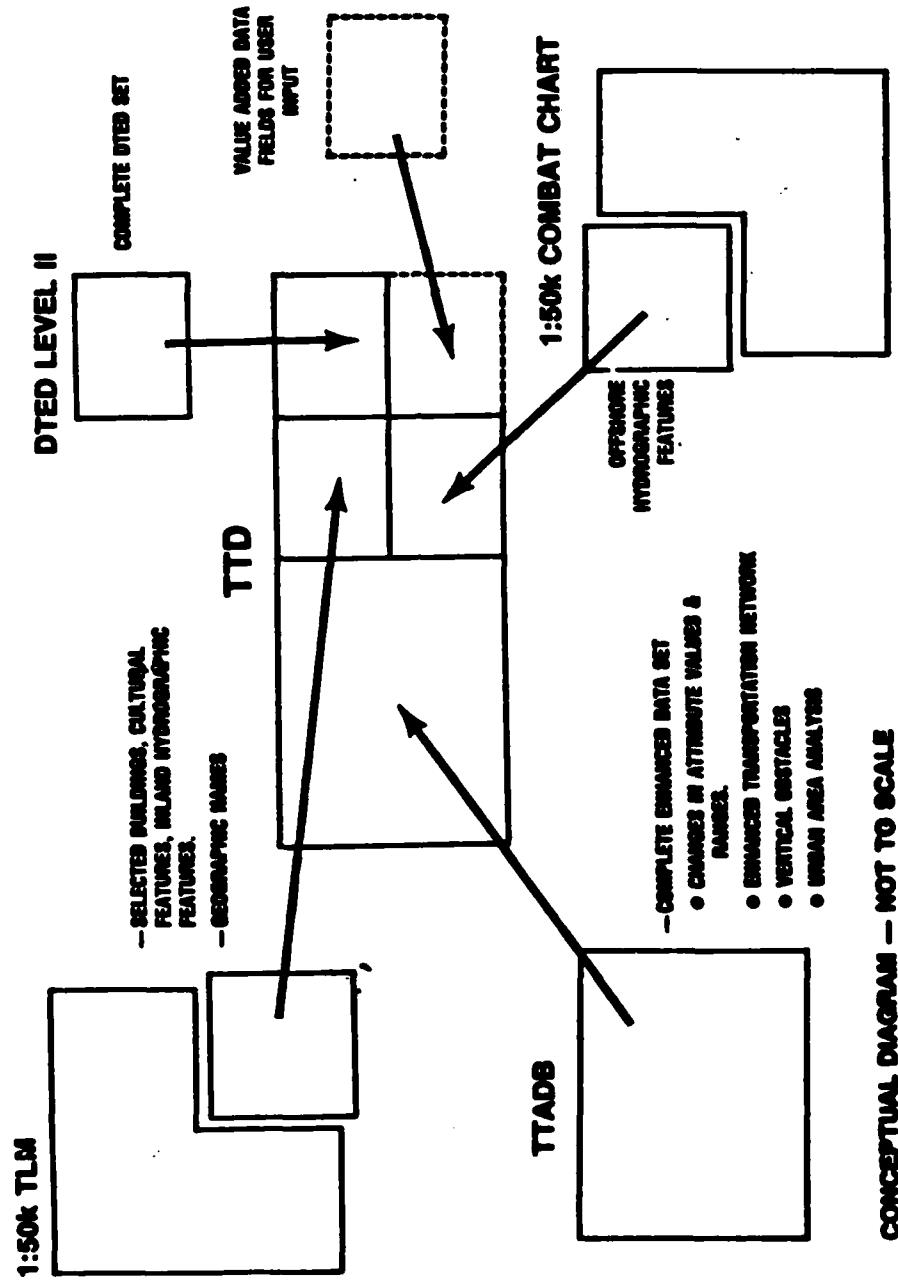


Figure 1. Tactical Terrain (TTD) Content

Table 1. TTD Prototype Characteristics

<u>Prototype</u> <u>Tactical Terrain Data (TTD)</u>	
1. PRODUCT SPECIFICATION: To be provided with prototype in December 1987.	
2. DENSITY:	Elevation data will be a one arc-second spacing (nominally 30 meters); feature density varies with actual density of depicted features (normally equivalent to that portrayed at 1:50,000 scale on line maps or factor overlays).
3. COORDINATE REFERENCE SYSTEM:	Geographic.
4. DATUM:	Horizontal - World Geodetic System (WGS) Vertical - Mean Sea Level (MSL)
5. CONTENT:	TTD contains both elevation and feature data. The elevation data consist of DTED Level II. The feature data are in a topologically integrated file containing data consistent with the TTADB thematic overlays and special features from the 1:50,000 Topographic Line Map (TLM) and combat chart as follows:
<u>Themes</u>	
Surface Configuration	Slope expressed in percentage ranges
Surface Materials	Soil types
Vegetation	Type, height, canopy closure
Transportation	Roads, bridges, tunnels
Surface Drainage	Gap widths, bank slopes/heights
Obstacles	Natural and/or man-made features that divert movement
Urban Areas	Predominant use/heights
Special Features from 1:50,000 topographic line maps and combat charts	Reefs, wells, gas/oil storage facilities
Note: User-defined Geographic Information System must have the capability to extract these user themes from the integrated file.	
6. STRUCTURE:	Elevation data - matrix; Feature data - Minimally Redundant Topology (MINITOPO). Feature categories will be those contained in the Feature Attribute Coding Standard (FACS).
7. FORMAT:	The American National Standards Institute's (ANSI) ISO-8211 data exchange format is the exchange format for the initial TTD prototype. To date, no spatial exchange format has been identified to integrate with ISO-8211.

Table 1. TTD Prototype Characteristics (Cont'd)

8. MEDIA: Initially 9 track, 1600 BPI magnetic tape; future prototypes may be CD-ROM optical disk; production TTD to be on suitable high density, durable media (such as optical digital disk).

9. STANDARD FILE SIZE: 15 minute by 15 minute cell.

10. ACCURACY:

	<u>Minimum Stated User Requirements</u>	<u>MK90 Capability</u>
<u>Elevation</u>		
Absolute Horizontal	130 meters CE 90%	
Point to Point Horizontal	30 meters CE 90%	The accuracies achieved
Absolute Vertical	+/- 30 meters LE 90%	by MK90 production will
*Point to Point Vertical	+/- 20 meters LE 90%	exceed these minimum
<u>Features</u>		user accuracy
Absolute Horizontal	125 meters CE 90%	requirements though DMA
*Point to Point Horizontal	50 meters CE 90%	cannot currently
Heighting accuracy for features	+/- 20 meters LE 90%	quantify this accuracy
		improvement.

*Current product specifications do not require point to point accuracies but MK90 production objectives are as stated.

11. AREA COVERAGE: To be identified by customers in the 1988 area requirements process; first prototype to cover one 15' X 15' area (approximately 22 km X 27 km) of Fort Hood, TX.

12. APPLICATIONS: TTD, as the basic operational terrain data set for future land combat, will provide terrain information that is critical to planning and executing joint operations including close air support missions, amphibious operations, and land combat operations. These data will support such diverse tasks as terrain visualization, mobility/counter mobility planning, site/route selection, reconnaissance planning, fire planning, communication planning, navigation, and munition guidance.

13. DISTRIBUTION POLICY: Distribution of these data will be limited to agencies within the Executive Branch of the U.S. Government and qualified DoD contractors.

14. STORAGE REQUIREMENTS: Initial TTD prototype is approximately 20 MB. Production TTD storage requirements will vary depending upon the density of depicted features.

15. CLASSIFICATION: Initial prototype will be unclassified. Future prototypes and/or production TTD may be classified.

16. POINTS OF CONTACT: DAMI-ISP MAJ Jens (202)695-5509, AV 225-5509; HQ DMA(PRW) LTC Porter (202) 653-1453, AV 294-1453.

Prototype Evaluation

The U.S. Army Engineer Topographic Laboratories (USAETL) is the lead agency responsible for evaluation of the TTD prototype. In this role, USAETL prepared a schedule for the evaluation and initially presented it at the Joint DOD TTD Working Group meeting in Jul. Though each service will conduct their own independent evaluation of the prototype, major schedule milestones will be adhered to by all the services.

In order to ensure both a complete and a timely evaluation of the prototype, a two-phased evaluation is planned. Phase I is scheduled from approximately 1 Mar through 31 Dec 1988. All evaluators will be encouraged to participate in this phase of the evaluation to the extent that they are able as this will be the best opportunity to influence design of MK-90 production TTD. Phase II of the evaluation will run concurrently with Phase I, its purpose is to accommodate those users that cannot meet the 31 Dec 1988 completion date. Currently, Phase II has no firm completion date.

Key events that are planned in the next few months prior to delivery of the prototype in Dec 1987 include: (1) identifying evaluation participants through an introductory cover letter and user background questionnaire that will be sent to potential TTD users; and (2) scheduling technical exchange meetings to disseminate technical information on the prototype and also to serve as a forum for answering user questions regarding implementation of TTD on their system.

In the Jan-Feb 1988 time frame, following delivery of the prototype, USAETL will conduct a short evaluation to ensure the basic integrity of the data set. Following this analysis, the prototype will be released from USAETL to joint service evaluators at a scheduled TTD programmer's workshop. Technical exchange meetings are then scheduled periodically during the evaluation for exchange of information on difficulties encountered and to disseminate lessons learned. Each service is individually responsible for coalescing the evaluation results of their participating systems/activities and for preparing a report for delivery to DMA by 31 Dec 1988.

Prototype User's Guide

In conjunction with evaluation of the TTD prototype, USAETL also has the responsibility for preparation of a User's Guide. This guide will accompany each TTD prototype tape and will serve as the main reference source for the evaluation.

The User's Guide will play a very important role in the evaluation by providing information that will help users quickly understand the unique aspects of the TTD prototype. To achieve this objective, both a top-level overview as well as in-depth technical details will be presented. The intent is to convey this information in such a way as to create a very readable document; that is, a document which is concise, to the point and that will not bore our audience.

The User's Guide will contain important information concerning how to read the tape onto the user system. For example, information will be included which describes how to retrieve TTD features based upon the DMA Feature Attribute Coding Standard (FACS). This information is required because FACS, which does not correlate one-to-one to user described features, is used to input features into the TTD data set. In addition, specific TTD applications will be discussed to give the user real examples of the uses of TTD data. Information detailing the format and data structure will be included to ensure the user is as comfortable as possible with the TTD prototype. Completion of the TTD User's Guide will coincide with release of the prototype in late Dec 1987. Final revisions, if required, will be made coincident with USAETL's Jan-Feb 1988 "shakedown" evaluation of the prototype. Initial distribution to joint service evaluators will occur at the scheduled TTD programmer's workshop.

The Future

There are two key events coming up in the near future that are critical to the evolution of TTD as a standard DMA product. One of these is the baselining of TTD in the MK 90 system. This will occur in the Jan-Mar 1988 time frame and will ensure that the MK 90 system will have the capability to produce TTD when the system comes on-line in the early 1990s. Hand-in-glove with the baselining of TTD is determination of the joint service's geographic area requirement. Army estimates alone have put the area requirement in excess of 6,000 15' x 15' cells; this estimate, however, must be firmed up through DMA's normal area requirements process. To accomplish this, the Unified and Specified Commands will be asked to state their TTD area requirement to DMA in the Jun 1988 time frame. The numbers that are distilled from this process will be used to help size the MK90 system.

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